

ASPECTS OF THE WEED COMPONENT OF THE SPONTANEOUS
ILLINOIS VASCULAR PLANT FLORA

R. D. Henry
The R. M. Myers Herbarium
Western Illinois University, Macomb, IL 61455

ABSTRACT: There are 442 weed species in the spontaneous Illinois vascular flora which represent about 16% of this flora. Native plants comprise 63% of these species. Eighty-three percent of the alien weeds are from the old world, 46% were once cultivated and 82% were introduced before 1922. Most (97%) of the weed species are angiosperms with the Compositae being the largest family. Eight families consist of all weed species. Seventy-four percent of the weed species are herbaceous, 40% poisonous to humans, 13% poisonous to livestock, 22% drug plants, 88% terrestrial, 65% perennial, 68% occur throughout the state, and 48% are common in the state. From 1803-1978 there were 2.5 weed species entering the flora per year but the length of time for a plant to become a weed varies. It is suggested that weed lists should be carefully made always using specific epithets for all plants as well as consideration of their frequency and distribution in addition to their ecosystem context. Probably the number of weed species (perhaps mostly aliens) will increase as population trends and agricultural practices cause more disturbed land. This trend will occur at the expense of the native flora and ecosystem.

INTRODUCTION

Vascular plant weeds have been a long time antagonist of mankind. Batra (1982) states that weeds are potentially the most damaging pests in agroecosystems and lists their effects and thus the need to control them. Boyer (1982) cites weedy competitors as a cause of decreased crop yields and McWhorter and Patterson (1980) state weeds are estimated to cause a 10 to 15% reduction in soybean yield and quality for a loss of more than 350 million dollars annually. However, it should be recalled that plants, even if they are weeds, are first and foremost a part of the flora ecosystem and should be primarily studied in such a context. The purpose of this paper is to present a profile of the vascular plant weeds of Illinois from the botanical perspective of them being a part of the dynamic flora of the state. Hopefully, this will indicate the character and trends of the weed flora which would be useful in the understanding and management of them.

The vascular plants considered to be present-day weeds in Illinois are those published in Lopinot (1981), Turgeon et al. (1980), Wax et al. (1981), and Fermanian et al. (1982). When the

specific epithet was not given but only the genus name or spp. or citations such as "similar," "another," "other," etc., the species included in this analysis were those plants in Holstun et al. (1971) which are also in Mohlenbrock and Ladd (1978). Family and species nomenclature was standardized to Mohlenbrock (1975). Hybrids and infraspecific taxa were excluded except when they were the only species. Mohlenbrock (1975) and Mohlenbrock and Ladd (1978) were used as the basis for the plants that compose the present-day spontaneous vascular flora of Illinois.

RESULTS

1. The Native and Alien Weed Species

There are 442 vascular plant weed species which represent 15.8% of the present-day species in the spontaneous Illinois vascular plant flora. Of these weed species 162 (37%) are aliens and 280 (63%) native plants. Of the Illinois flora native plants 280 (14%) are weeds and of the alien plants in the flora 162 (20%) are weeds. The seven legislated noxious Illinois weed species (Ill. Dept. of Agric., 1978) comprise 1.58% of the present-day Illinois weeds; of the seven, 5 (71%) are aliens and 2 (29%) are native. Actually there is another plant on the Illinois noxious weed list, Sorghum aluum, but surprisingly it is not on the published weed lists for Illinois used in this paper. Of William's (1980) 37 purposefully introduced plants into the United States that have become noxious (= non-poisonous) or poisonous weeds, 10 (27%) are weeds in Illinois. These 10 species represent 2.3% of the Illinois weed flora. Half of these 10 species are noxious and half are poisonous. Of Holm's (1969) 10 worst weeds in the world five (all aliens) occur in Illinois but only 4 (40%) (not Echinochloa colonum (L.) Link) are Illinois weeds and these represent only 0.9% of the Illinois weeds.

2. Analysis of the Alien Weed Species

Of the alien weed species 75 (46%) were once cultivated plants. Eighty-two percent of the alien weed species were introduced into Illinois before 1922, 11% between 1922-1955 and 7% from 1956-1978. Between 1803 and 1978 the average number of alien weed species introduced per year was 0.93. The number of alien weed species introduced per year from 1803-1921 was 1.1, between 1922-1955 was 0.54 and between 1956-1978 was 0.50 indicating a decrease to date per year for alien weed species; however, the number of aliens introduced into the Illinois spontaneous vascular flora in recent years is increasing since between 1956 and 1978 9.4 species were introduced per year (Henry & Scott 1981). Since there is a lag between time of introduction and time of becoming a weed a prediction could be made that in the future perhaps there will be an increasing number of alien weeds.

Most of the alien weeds are from the old world (83%) while the fewest (7%) originated from the new world tropics. The rest (10%) are from the United States outside of Illinois most being from the west (9%) (7% from the west and 2% from the southwest); eastern U.S. contributed 1%.

3. Taxonomic Distribution of the Weed Species

The weed species occur in four divisions. Five (1.1%) are Equisetophyta, one (0.2%) is a Polypodiophyta, eight (1.8%) are Pinophyta and 428 (96.9%) are Magnoliophyta. Thus the weed species are about 1% pteridophytes, 2% gymnosperms and 97% angiosperms. Within the angiosperms 72 (16.8%) are Liliopsida (monocots) and 356 (83.2%) are Magnoliopsida (dicots). The monocots represent 16.3% of the total weed flora species whereas the dicots compose 80.5%.

The weed species occur in 72 families. One (1.4%) belongs to the Equisetophyta, one (1.4%) is in the Polypodiophyta, two (2.8%) in the Pinophyta and 68 (94.4%) are Magnoliophyta. Thus the weed families are about 3% pteridophytes, 3% gymnosperms and 94% angiosperms. Within the angiosperms 12 (17.6%) are Liliopsida and 56 (82.4%) are Magnoliopsida. The monocots represent 16.7% of the total weed flora families whereas the dicots comprise 77.8%. The five largest families in the weed flora are Compositae (78), Poaceae (Gramineae) (36), Rosaceae (25), Fagaceae (19) and Polygonaceae (16). There are eight families (11% of the weed families and 5% of the families in the Illinois vascular flora) that consist of 100% weed species: Aizoaceae, Cabombaceae, Martyniaceae, Nelumbonaceae, Nymphaeaceae, Phytolaccaceae, Typhaceae and Zannichelliaceae. These families are all herbaceous angiosperms two being monocot and six dicot.

The weed species occur in 188 genera. One (0.5%) belongs to the Equisetophyta, one (0.5%) is in the Polypodiophyta, two (1.0%) in the Pinophyta and 184 (98%) are Magnoliophyta. Thus the weed genera are about 1% pteridophytes, 1% gymnosperms and 98% angiosperms. Within the angiosperms 36 (19.6%) are Liliopsida and 148 (80.4%) are Magnoliopsida. The monocots represent 19.1% of the total weed flora genera and the dicots 78.7%. The largest genera in the weed flora are Quercus (19), Polygonum (12), Carya (9), Amaranthus (9), Potamogeton (9), Veronica (9), Prunus (8), Rubus (8), Salix (7), Pinus (7), Populus (7), Aster (7), Bidens (7), and Solidago (7). There are 51 genera (27% of the weed genera and 6% of the genera in the Illinois vascular flora) that consist of 100% weed species: Abutilon, Achillea, Agrostemma, Berteroa, Brasenia, Cabomba, Campsis, Cannabis, Capsella, Cardaria, Carduus, Cenchrus, Cephalanthus, Cichorium, Conium, Convolvulus, Corylus, Cycloloma, Cynodon, Dracocephalum, Echinocystis, Eleusine, Ellisia, Erigeron, Fraxinus, Galinsoga, Glecoma, Kochia, Maclura, Mollugo, Morus,

Nelumbo, Nepeta, Nuphar, Nymphaea, Onopordum, Pastinaca, Phytolacca, Proboscidea, Prunella, Pteridium, Rhus, Sicyos, Sonchus, Symphoricarpos, Taraxacum, Teucrium, Typha, Ulmus, Zannichellia and Zosterella. Of these genera 42 are herbaceous and 9 woody; 50 are angiosperms (44 dicots, 6 monocots) and one is a fern.

4. Woody and Herbaceous Habit of the Weed Species

Of the weed species 116 (26.2%) are woody and 326 (73.8%) are herbaceous. Of the woody plants 96 (82.8%) are native and 20 (17.2%) are aliens whereas of the herbaceous species 184 (56.4%) are native and 142 (43.6%) are alien. All of the pteridophytes are herbaceous, all of the gymnosperms woody and in the angiosperms 25.2% (108) are woody and 74.8% (320) are herbaceous. Of all the weed families (72) 18 (25%) are woody and 57 (79%) are herbaceous (the total is over 100% due to an overlap of 3 families). Of all the weed genera (188) 29 (15.4%) are woody and 160 (85.1%) are herbaceous (the total exceeds 188 and 100% due to the overlap of the one genus Artemisia). The largest herbaceous weed families are Compositae (77), Poaceae (36), Polygonaceae (16), Cruciferae (15) and the Scrophulariaceae and Cyperaceae each with 2 species. The largest woody weed families are Rosaceae (22), Fagaceae (19), Salicaceae (14), Juglandaceae (9), and Ulmaceae (8). The largest herbaceous weed genera are Polygonum (12), Amaranthus (9), Potamogeton (9), Veronica (9), Aster (7), Bidens (7), Solidago (7), Cuscuta (6), Scirpus (6), Erigeron (6), Eupatorium (6), Physalis (6), Artemisia (5), Carex (5), and Equisetum (5). The largest woody weed genera are Quercus (19), Carya (9), Prunus (8), Rubus (8), Salix (7), Populus (7), Pinus (7), Acer (6), and Ulmus (6). Listed in part 3 of this paper are the 8 families that are 100% herbaceous weeds (there are no woody 100% weed families) and the 100% weed (42 herbaceous and 9 woody) genera.

5. Poisonous Weed Species

Of the weed species 175 (39.6%) are poisonous to humans and 57 (12.9%) are poisonous to livestock. Plants poisonous to humans were determined from Hardin and Arena (1974) and for livestock from Evers and Link (1972).

6. Drug Plant Weed Species

Ninety-five (21.5%) of the weed species were on Tehon's (1951) list of Illinois drug plants.

7. Habitat of the Weed Species

Of the weed species 55 (12.4%) are aquatic and 387 (87.6%) are terrestrial.

8. Duration of the Weed Species

Of the weed species 131 (29.6%) are annual, 23 (5.2%) biennial and 288 (65.2%) are perennial.

9. Principal Illinois Distribution of the Weed Species

Based on Mohlenbrock and Ladd's (1978) distribution maps 299 (67.7%) of the weed species occur throughout the state while 85 (19.2%) occur in the northern two-thirds and 58 (13.1%) occur in the southern two-thirds of the state.

10. Frequency of Occurrence of the Weed Species

Mohlenbrock and Ladd (1978) was the source of the species county occurrence and the descriptors used were adapted from Schmid (1982); rare is 4% or less, occasional is 5-30%, often is 31-64% and common is 65-100%. Thirty-three (7.5%) of the weed species are rare (found in 1-4 counties), 95 (21.5%) are occasional (found in 5-31 counties), 103 (23.3%) occur often (32-65 counties) and 211 (47.7%) are common (66-102 counties).

11. Chronistic Changes of the Weed Species

In order to provide some information on the status and change of the Illinois weed flora through time reference has been made to Michaux (1803) the first plant collector in Illinois, to Mead (1846) who published the first flora of Illinois, to Flagg and Burrill (1878) who published a list of the plants of Illinois and Darlington (1922) who published a list of the introduced weed flora of Illinois. The data from these publications are compared to the data derived from the sources given in the introduction that were used as the sources of the weeds and vascular plants that comprise the present-day Illinois flora.

Michaux collected 89 plants, annotated none as weeds, but listed 31 (7%) of the species that are present-day weeds and which represented 35% of his Illinois collections. Only two of these 31 plants are aliens (Polygonum aviculare and P. hydropiper). Mead catalogued 913 plants, annotated 17 (1.8%) as weeds, but listed 229 (51.8%) of the species that are present-day weeds which represented 25% of his Illinois plants. Of the 17 annotated weeds 5 (29.4%) were alien (Chrysanthemum leucanthemum, Amaranthus hybridus, Digitaria sanguinalis, D. ischaemum, Bromus secalinus) and three (Cirsium discolor, C. muticum, C. pumilum) are not on the present-day weed list.

Flagg and Burrill catalogued 1570 plants, annotated 43 (2.7%) as weeds, but listed 332 (75.1%) of the species that are present-day weeds which represented 21% of his Illinois plants. However, it is of interest to note that of the 332 present-day weed species that are on their list 14 were annotated as cultivated (Acer platanoides, Prunus cerasus, P. avium, Rosa multiflora, Lonicera japonica, Helianthus annuus, Tragopogon porrifolius, Physalis alkekengi, Maclura pomifera, Populus alba, P. nigra italica, Pinus sylvestris, P. resinosa, Sorghum bicolor). Of the 43 annotated weeds 27 (62.8%) were alien and 14 are not on the present-day weed list (Linum usitatissimum, Agrimonia gryposepala, A. parviflora, Xanthium spinosum, Ambrosia bidentata, Polyomia canadensis, P. uvedalia, Bidens beckii, Anagallis arvensis, Nicandra physaloides, Chenopodium glaucum, C. murale, C. botrys, Euphorbia helioscopia).

Darlington's paper concerned only herbaceous alien species introduced before 1922. He did not annotate any specifically as weeds since he considered that any foreign plant may potentially be a weed. Of his 256 species only 109 (42.6%) are present-day weeds. Henry and Scott (1981) concluded that there were only 226 valid alien species on Darlington's list, of which the 109 present-day weeds would be 48.2%; also Henry and Scott concluded that the total number of alien species introduced into the spontaneous Illinois vascular flora before 1922 was actually 440 of which 142 (32.3%) are presently weeds. These 142 alien species introduced before 1922 represent 32% of the present-day Illinois weed species.

From 1803 to 1978 the number of weed species entering the Illinois spontaneous vascular flora per year is 2.5 (native plants being 1.6 and alien 0.9 species per year). During this time period the percent of native and alien species that make up the weed flora has not greatly changed since native plants were 71% and alien plants 29% of the annotated weeds in Meads 1846 flora and they are 63% and 37% respectively of the present weed flora. However, the proportion of the Illinois flora that are weeds has greatly increased being 17 (1.9%) in 1846, 43 (2.7%) in 1878, 22 (10.1%) in 1954 and 442 (15.9%) in 1978. Woody plants apparently have been weeds only in the last 30 years and now constitute 26% of the weeds, a rather rapid rise in proportion. In 1922, Darlington stated "Shrub and tree introductions--are excluded, as they are hardly to be counted as weeds" (although he did include two shrubs (Rosa eglanteria and Lycium halimifolium) in his list and mentioned Populus alba and Salix alba as examples of exclusions. All of these four plants except Lycium halimifolium are present-day weeds, however). Buchholtz et al. in 1954 only listed four species as woody weeds (Solanum dulcamara, Toxicodendron radicans, Campsis radicans, Rosa sulfata). Today there are 116 species of woody plants that are weeds. Neither Mead (1846) nor Flagg and Burrill (1878) included any woody plants in their annotation of weeds.

DISCUSSION

Like the vascular flora of the state, the weed flora is also dynamic in that it changes with time and certainly is not static. Therefore, it needs to be continually monitored and revised for changes including additions and deletions. Changes in the weed flora can be due to effectiveness of control methods, land management, changes in weather, grazing, plant growth and competition, plant introductions, pollution, change in species numbers and distribution, changes in habitat and methods of cultivation (see Froud-Williams et al. (1981) and Oldenstadt et al. (1982) for examples of the latter).

Several examples of these changes can be given. The years for the additions and deletions from the weed list were obtained from a comparative study of Lopinot (1963, 1965, 1968, 1971, 1976, 1979, 1981) Buchholtz et al. (1954), Slife et al. (1960) and Wax et al. (1981). Some native plants became weeds very early since in 1846 Mead annotated as weeds 12 such plants including Solanum carolinense, Erigeron canadensis, Ambrosia trifida and A. artemisiifolia which are on the present-day weed list. Muhlenbergia frondosa, Chenopodium hybridum and Amaranthus albus are native plants that were not added to the published weed list until 1960. Utricularia vulgaris was added in 1965, Cabomba caroliniana in 1976 and Teucrium canadense, Physalis subglabrata and Apocynum sibiricum in 1981. Likewise with alien species that have become weeds, the time varies between the year of introduction and when they are listed as weeds. Some alien plants became weeds soon after introduction as Chrysanthemum leucanthemum, Digitaria sanguinalis, D. ischaemum and Bromus secalinus which Mead annotated as weeds in 1846. Matricaria matricarioides was added to the weed list in 1960 which was 135 years after its introduction into Illinois in 1825. Other examples are 120 years (1861-1981) for Conium maculatum, 103 years (1857-1960) for Poa annua, 69 years (1912-1981) for Amaranthus powellii, 32 years (1949-1981) for Rosa multiflora, 30 years (1930-1960) for Carduus nutans, 27 years (1933-1960) for Euphorbia esula, 17 years (1938-1955) for Setaria faberii (see Jones & Fuller 1955, p. 79), and 2 years (1963-1965) for Naias minor.

Deletions from the published weed lists show that the duration of time that a plant can be a weed also varies. Examples of native plant deletions include in 1965 Naias flexilis, Potamogeton zosteriformis, P. gramineus, P. richardsonii and P. fresii; deleted in 1960 was Acalypha virginica and in 1981 was Acorus calamus and Cuscuta pentagonia. Alien weed deletions include in 1960 Tanacetum vulgare 114 years after its introduction and Tragopogon pratensis 69 years after its introduction. In 1981 Centaurea maculosa and Cucurbita foetidissima were deleted 36 and 64 years respectively after their first occurrence in the Illinois flora.

Every plant can under a given circumstance be considered a weed and thus the selection of plants to be included or excluded when preparing a list of weeds is necessarily an arbitrary decision. It is possible that a given species can simultaneously be both a weed and not a weed. It is well known that soybeans in a cornfield (or vice versa) are weeds for example (although soybeans or corn are not on the present-day weed list). Dandelions are not weeds when they are cultivated but are in lawns. Wax et al. (1981) gives another example using woody plants when on page 286 they state that a number of shrubs and trees often occur as brush in pastures and "under these conditions" are considered weeds. Weedy plants are often additionally characterized as for example as "not troublesome" (Wax et al. (1981) p. 189) or "minor" weeds (Wax et al. (1981) p. 274) the implications of these status modifiers not always being clear. When a previously uncultivated area of vegetated land is cleared and/or drained and prepared for crops all plants present would be weeds; so also would all plants on any area being plowed or cultivated as well as all plants sprayed with herbicides or otherwise controlled along highways, railroads and under utility lines.

Lists of weeds are generally as accurate as they can be perhaps but nevertheless need continual re-evaluation. There probably will always be disagreement about which plants are to be included as weeds. I would suggest especially that more thought be given to a species (particularly native ones) role in the flora and the ecosystem before it is given the label "weed" which usually subjects it to an extermination program. Also perhaps occurrence, frequency and distribution should be viewed more closely in the preparation of a weed list. For example, 33 (17 alien, 16 native) weeds in Illinois have a rare frequency of occurrence in the state in that each is in only 4% or less (i.e. 1-4) counties. Wax et al. (1981) indicate 4 Illinois weeds (3 alien, 1 native) on their distribution maps to be rare. The Illinois weed species also allows for the inclusion of 2 threatened and 9 endangered species listed in Bowles et al. (1981) as well as the state tree. It is interesting to note that three native species now on the state endangered list, Potamogeton gramineus, P. pulcher and P. vaseyi, (Bowles et al. (1981) were considered weeds in 1963 (Lopinot 1963) but not since 1965 (Lopinot 1965, 1968, 1971, 1976, 1979, 1981). One wonders what effect the designation weed, with the resulting "control" efforts, had on them attaining such a population level that they have attained endangered status in such a relatively short period of time. Since the 280 native plant weed species represent 14% of the present-day Illinois native vascular plants and 10% of the present-day Illinois spontaneous vascular flora, one also wonders about the danger to the existence of this part of the flora since being weeds they are the object of the "control" program. Wax et al. (1981)

includes Rorippa austriaca in the state (rarely) although it has as yet not been recorded for the state per Mohlenbrock (1980); likewise Reed (1970) includes Eichornia crassipes as a weed in Illinois but Mohlenbrock (1975) does not record it for the state.

In order to have a more judicious selection of weed plants I would like to recommend that published weed lists:

1. Always list specific epithets. Listing genera only, spp., other plants, similiar plants, etc, is unsatisfactory for accurate weed analysis, monitoring, evaluation or management purposes;
2. Account for the occurrence, frequency and distribution of the included plants particularly native species. Rare, threatened or endangered plants should not be included or should any species on the verge of becoming so;
3. Take into consideration the plants being an integral part of the flora and ecosystem, particularly native plants. Any weed management program should not be a detriment to or at the expense of the ecosystem, particularly of native vegetation. Weed selection should involve other criteria besides only being undesirable to man's present economy and desires;
4. State the definite threshold criteria used for a plant having attained weed status. Weeds should be objectively rather than subjectively selected;
5. Apply to smaller rather than larger areas. The list of weeds for many states is not as useful and accurate as one for one state or county.

Hopefully, this paper will cause its readers to use a more precise and considered judgement in the selection of weed plants. As the population grows more rapidly and moves to the open country and towards rural life-styles (Long and DeAre, 1982; Beller et al., 1982) in conjunction with continuing intensive agriculture we might expect as a result more plants categorized as "weeds" at the expense of the native (natural) flora and ecosystem for which amends and mitigations should be made.

SUMMARY

1. There are 442 weed species in the spontaneous Illinois vascular flora. These species represent about 16% of this flora. From 1803-1978 there were 2.5 weed species entering the flora per year.

2. Thirty-seven percent of the weed species are alien and 63% native.
3. Of the alien weed species 46% were once cultivated, 82% were introduced before 1922, and 83% are from the old world.
4. One percent of the weed species are pteridophytes, 2% gymnosperms and 97% angiosperms. They occur in 72 families the largest being the Compositae, Poaceae and Rosaceae. Eight families consist of 100% weed species.
5. The weed species are in 188 genera, 51 of which consist of 100% weed species.
6. The weed species are 26% woody and 74% herbaceous. Woody plants have only been weeds for the past 30 years.
7. Forty percent of the weed species are poisonous to humans and 13% to livestock.
8. Twenty-two percent of the weed species are drug plants.
9. Twelve percent of the weed species are aquatic and 88% terrestrial.
10. Of the weed species 30% are annual, 5% biennial and 65% perennial.
11. Sixty-eight percent of the weed species occur throughout the state while 19% occur in the northern two-thirds and 13% occur in the southern two-thirds of the state.
12. Of the weed species 7% are rare, 22% occasional, 23% often and 48% common in the state.
13. The length of time for a plant to become a weed varies from almost immediately to over a hundred years. The duration of time a plant is a weed also varies.
14. It is recommended that weed lists should be judiciously made using definable threshold criteria, that specific epithets always be given, that more importance be given to criteria as occurrence and distribution as well as being in a flora and ecosystem context, that areas for such lists be relatively smaller rather than larger and that the weed flora should be continually monitored and evaluated.
15. Perhaps there will be more weed species (possibly mostly aliens) in the flora in the future as land disturbance increases as the population increases in rural areas and

agricultural practices change and intensify. Unfortunately this trend will occur at the expense of the native (natural) flora and ecosystem.

LITERATURE CITED

- Batra, S.W.T. 1982. Biological Control in Agroecosystems. *Science* 215:134-139.
- Beller, A.H., Quinn, J.A. and Sofranko, A.J. 1982. Shifting Populations in Illinois. *Illinois Research* 24(3):14-16.
- Bowles, M.L., Diersing, V.E., Ebinger, J.E., and Schultz, H.C. 1981. Endangered and Threatened Vertebrate Animals and Vascular Plants of Illinois. Illinois Department of Conservation, Springfield.
- Boyer, J.S. 1982. Plant Productivity and Environment. *Science* 218:443-448.
- Buchholtz, K.P., Grigsby, B.H., Lee, O.C., Slife, F.W., Willard, C.J., and Volk, N.J., 1954. Weeds of the North Central States. Univ. of Illinois Agric. Expt. Station Circular 718, Urbana.
- Darlington, H.T. 1922. The Introduced Weed Flora of Illinois. *Trans. Ill. State Acad. Sci.* 15:171-184.
- Evers, R.A., and Link, R.P. 1972. Poisonous Plants of the Midwest and Their Effects on Livestock. Univ. of Illinois College of Agric. Special Publ. 24, Urbana-Champaign.
- Fermanian, T.W., Shurtleff, M.C. and Randell, T. 1982. 1982 Turfgrass Pest Control. Univ. of Illinois College of Agric. and Cooperative Extension Service Circular 1076, Urbana-Champaign.
- Flagg, W.C. and Burrill, T.J. 1878. Catalogue of the Flowering and Higher Flowerless Plants of Illinois: Native, Introduced and Cultivated. *Rept. Ill. Industrial. Univ.*, 9:219-287, 291-297.
- Froud-Williams, R.J., Chancellor, R.J. and Drennan, D.S.H. 1981. Potential Changes in Weed Floras Associated with Reduced-Cultivation Systems for Cereal Production in Temperate Regions. *Weed Res.* 21(2):99-109.
- Hardin, J.W. and Arena, J.M. 1974. Human Poisoning from Native and Cultivated Plants. 2nd ed. Duke Univ. Press, Durham, North Carolina.

- Henry, R.D. and Scott, A.R. 1981. Time of Introduction of the Alien Component of the Spontaneous Illinois Vascular Flora. *Amer. Midl. Nat.* 106:318-324.
- Holm, L. 1969. Weed Problems in Developing Countries. *Weed Sci.* 17:113-118.
- Holstun, J.T. Jr., Alex, J., Darrow, R.A., Erickson, L.S., Frank, P.A., Johnson, B.G., Miller, J.F., Robocker, W.C., Williams, J.L., and Scudder, W.T. 1971. Report-Subcommittee on Standardization of Common and Botanical Names of Weeds. *Weed Sci.* 19:435-476.
- Illinois Department of Agriculture. 1978. Illinois Noxious Weeds: Their Description and Control. Springfield.
- Jones, G.N. and Fuller, G.D. 1955. Vascular Plants of Illinois. Univ. of Ill. Press, Urbana, and Ill. State Museum, Springfield.
- Long, L. and DeAre, D. 1982. Repopulating the Countryside: A 1980 Census Trend. *Science* 217:1111-1116.
- Lopinot, A.C. 1963, 1965, 1968, 1971, 1976, 1979, 1981, Aquatic Weeds: Their Identification and Methods of Control. *Fishery Bull.* No. 4, Ill, Dept. of Conservation, Springfield.
- McWhorter, C.G. and Patterson, D.T. 1980. Ecological Factors Affecting Weed Competition in Soybeans. In: Corbin, F.T. ed., *World Soybean Research Conference II: Proceedings* pp. 371-392. Westview Press, Boulder, Colorado.
- Mead, S.B. 1846. Catalogue of Plants Growing Spontaneously in the State of Illinois, the Principal Part near Augusta, Hancock County. *Prairie Farmer* 6:35-36;60;93;119-122.
- Michaux, A. 1803. *Flora Boreali-Americana*. 2 vols. Paris. (1974 reprint by Hafner Press, New York).
- Mohlenbrock, R.H. 1975. Guide to the Vascular Flora of Illinois. Southern Illinois University Press, Carbondale.
- Mohlenbrock, R.H. 1980. The Illustrated Flora of Illinois-Flowering Plants: Willows to Mustards. Southern Illinois University Press, Carbondale.
- Mohlenbrock, R.H. and Ladd, D.M. 1978. Distribution of Illinois Vascular Plants. Southern Illinois University Press, Carbondale.

- Oldenstadt, D.L., Allan, R.E., Bruehl, G.W., Dillman, D.A., Michalson, E.L., Papendick, R.I. and Rydrych, D.J. 1982. Solutions to Environmental and Economic Problems (STEEP). Science 217:904-909.
- Reed, C.F. 1970. Selected Weeds of the United States. United States Dept. Agriculture, Agric. Handbook No. 366. Washington, D.C.
- Schmid, R. 1982. Descriptors Used to Indicate Abundance and Frequency in Ecology and Systematics. Taxon 31:89-94.
- Slife, F.W., Buchholtz, K.P. and Kommedahl, T. 1960. Weeds of the North Central States. Rev. ed. Univ. of Illinois Agric. Expt. Station Circ. 718, Urbana.
- Tehon, L.R. 1951. The Drug Plants of Illinois. Ill. Natural History Survey Circular 44, Urbana.
- Turgeon, A.J., Street, J.R., Giles, F.A., Shurtleff, M.C., and Randell, R. 1980. Illinois Lawn Care and Establishment. Univ. of Illinois College of Agric. and Cooperative Extension Service Circular 1082, Urbana-Champaign.
- Wax, L.M., Fawcett, R.S. and Isely, D. 1981. Weeds of the North Central States. Univ. of Illinois College of Agric. and Agric. Expt. Station Bulletin 772, Urbana-Champaign.
- Williams, M.C. 1980. Purposefully Introduced Plants that have Become Noxious or Poisonous Weeds. Weed Sci. 28:300-305.